



# PNE20060CPE-Q

200 V, 2 x 3 A dual common cathode hyperfast recovery rectifier

10 September 2021

Product data sheet

## 1. General description

High power density, hyperfast switching time dual recovery rectifier in common cathode configuration with high-efficiency planar technology, encapsulated in a CFP15B (SOT1289B) power and flat lead Surface-Mounted Device (SMD) plastic package.

## 2. Features and benefits

- Reverse voltage:  $V_R \leq 200$  V
- Forward current:  $I_F \leq 3$  A (per diode)
- Switching time:  $t_{rr} \leq 30$  ns
- Pt doped life time control
- Low inductance
- Power and flat lead SMD plastic package
- Package height typical 0.95 mm
- High power capability due to clip-bond technology
- Planar die design
- Qualified according to AEC-Q101 and recommended for use in automotive applications

## 3. Applications

- General-purpose rectification
- Hyperfast switching
- Solenoid control
- Piezo injection
- Freewheeling applications

## 4. Quick reference data

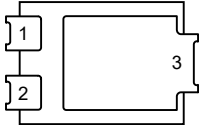
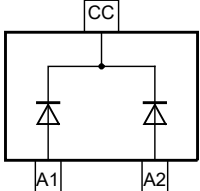
Table 1. Quick reference data

| Symbol                                 | Parameter                       | Conditions                                                       |     | Min | Typ | Max | Unit |
|----------------------------------------|---------------------------------|------------------------------------------------------------------|-----|-----|-----|-----|------|
| Per diode (unless otherwise specified) |                                 |                                                                  |     |     |     |     |      |
| $I_{F(AV)}$                            | average forward current         | $\delta = 0.5$ ; $f = 20$ kHz; square wave; $T_{sp} \leq 155$ °C |     | -   | -   | 3   | A    |
| $V_{RRM}$                              | repetitive peak reverse voltage | $T_j = 25$ °C                                                    |     | -   | -   | 200 | V    |
| $V_R$                                  | reverse voltage                 |                                                                  |     | -   | -   | 200 | V    |
| $V_F$                                  | forward voltage                 | $I_F = 3$ A; $T_j = 25$ °C                                       | [1] | -   | 870 | 940 | mV   |
|                                        |                                 | $I_F = 3$ A; $T_j = 125$ °C                                      | [1] | -   | 730 | 820 | mV   |
| $I_R$                                  | reverse current                 | $V_R = 200$ V; $T_j = 25$ °C                                     | [1] | -   | -   | 1   | µA   |
|                                        |                                 | $V_R = 200$ V; $T_j = 125$ °C                                    | [1] | -   | 1.5 | 35  | µA   |

[1] Very short pulse, in order to maintain a stable junction temperature.

5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description     | Simplified outline                                                                                     | Graphic symbol                                                                                    |
|-----|--------|-----------------|--------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| 1   | A1     | anode (diode 1) | <br>CFP15B (SOT1289B) | <br>aaa-030081 |
| 2   | A2     | anode (diode 2) |                                                                                                        |                                                                                                   |
| 3   | CC     | common cathode  |                                                                                                        |                                                                                                   |

6. Ordering information

Table 3. Ordering information

| Type number   | Package |                                                                                                    |          |
|---------------|---------|----------------------------------------------------------------------------------------------------|----------|
|               | Name    | Description                                                                                        | Version  |
| PNE20060CPE-Q | CFP15B  | plastic, thermal enhanced ultra thin SMD package; 3 leads; 2.13 mm pitch; 5.8 x 4.3 x 0.95 mm body | SOT1289B |

7. Marking

Table 4. Marking codes

| Type number   | Marking code |
|---------------|--------------|
| PNE20060CPE-Q | 200E<br>006C |

## 8. Limiting values

**Table 5. Limiting values**

In accordance with the Absolute Maximum Rating System (IEC60134)

| Symbol                                 | Parameter                           | Conditions                                                                                                                 |     | Min | Max  | Unit |
|----------------------------------------|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------|-----|-----|------|------|
| Per diode (unless otherwise specified) |                                     |                                                                                                                            |     |     |      |      |
| V <sub>R</sub>                         | reverse voltage                     | T <sub>J</sub> = 25 °C                                                                                                     |     | -   | 200  | V    |
| V <sub>RRM</sub>                       | repetitive peak reverse voltage     |                                                                                                                            |     | -   | 200  | V    |
| V <sub>R(RMS)lim</sub>                 | limiting RMS reverse voltage        |                                                                                                                            |     | -   | 140  | V    |
| I <sub>F</sub>                         | forward current                     | δ = 1; T <sub>sp</sub> ≤ 150 °C                                                                                            |     | -   | 4.2  | A    |
| I <sub>F(AV)</sub>                     | average forward current             | δ = 0.5; f = 20 kHz; square wave; T <sub>sp</sub> ≤ 155 °C                                                                 |     | -   | 3    | A    |
| I <sub>FSM</sub>                       | non-repetitive peak forward current | t <sub>p</sub> = 8.3 ms; single half sine wave (applied at rated load condition); T <sub>j(init)</sub> = 25 °C             |     | -   | 80   | A    |
|                                        |                                     | t <sub>p</sub> = 8.3 ms; single half sine wave (applied at rated load condition); per device; T <sub>j(init)</sub> = 25 °C |     | -   | 150  | A    |
| Per device, one diode loaded           |                                     |                                                                                                                            |     |     |      |      |
| P <sub>tot</sub>                       | total power dissipation             | T <sub>amb</sub> ≤ 25 °C                                                                                                   | [1] | -   | 1.66 | W    |
|                                        |                                     |                                                                                                                            | [2] | -   | 2.15 | W    |
| T <sub>J</sub>                         | junction temperature                |                                                                                                                            |     | -   | 175  | °C   |
| T <sub>amb</sub>                       | ambient temperature                 |                                                                                                                            |     | -55 | 175  | °C   |
| T <sub>stg</sub>                       | storage temperature                 |                                                                                                                            |     | -65 | 175  | °C   |

[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and standard footprint.

[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for cathode  $1\text{ cm}^2$ .

9. Thermal characteristics

Table 6. Thermal characteristics

| Symbol                       | Parameter                                        | Conditions  |     | Min | Typ | Max | Unit |
|------------------------------|--------------------------------------------------|-------------|-----|-----|-----|-----|------|
| Per device, one diode loaded |                                                  |             |     |     |     |     |      |
| $R_{th(j-a)}$                | thermal resistance from junction to ambient      | in free air | [1] | -   | -   | 90  | K/W  |
|                              |                                                  |             | [2] | -   | -   | 70  | K/W  |
| $R_{th(j-sp)}$               | thermal resistance from junction to solder point |             | [3] | -   | -   | 7   | K/W  |

- [1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.  
[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for cathode 1 cm<sup>2</sup>.  
[3] Soldering point of cathode tab.

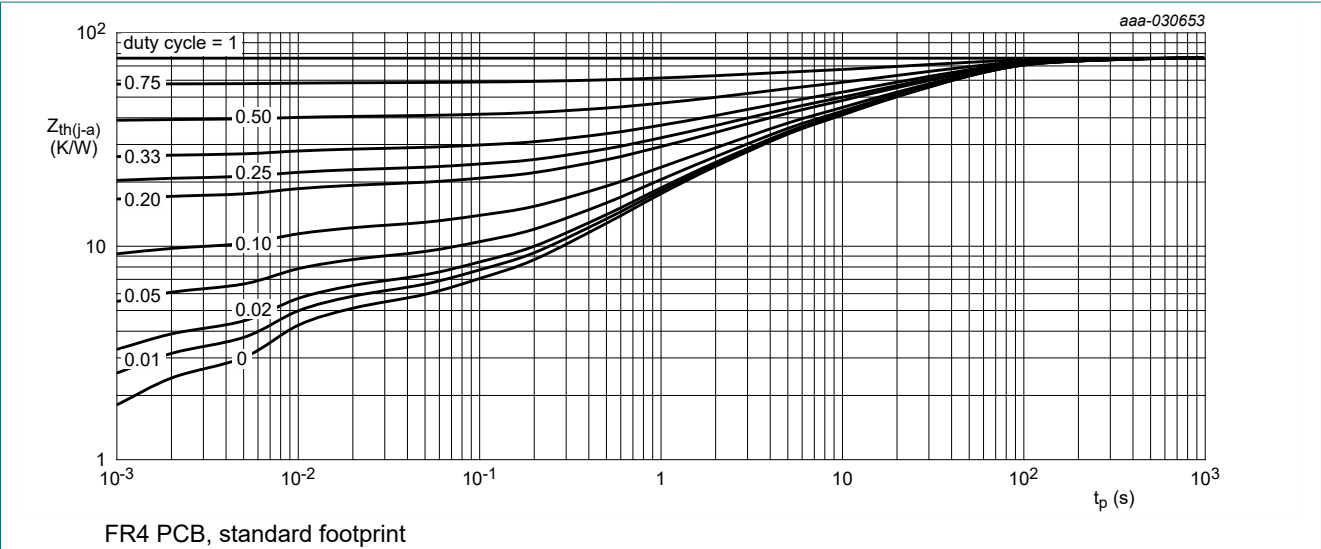


Fig. 1. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

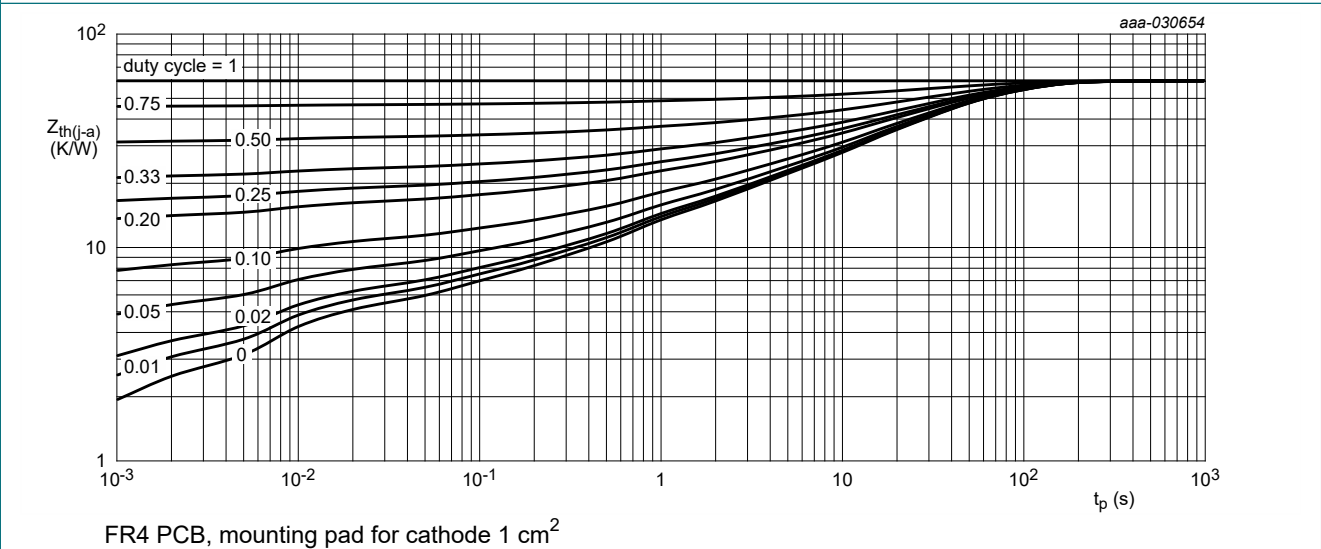


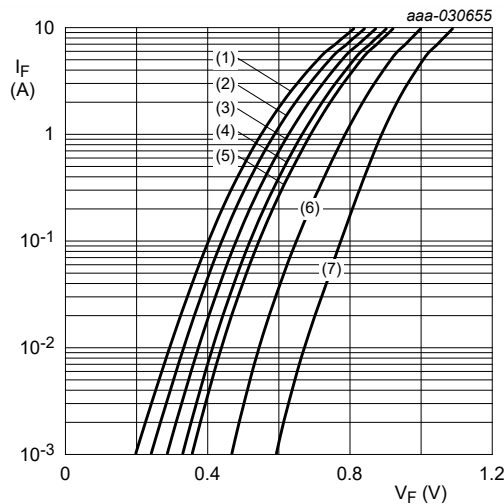
Fig. 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

## 10. Characteristics

Table 7. Characteristics

| Symbol                                        | Parameter                           | Conditions                                                                                                       |     | Min | Typ | Max | Unit          |
|-----------------------------------------------|-------------------------------------|------------------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|---------------|
| <b>Per diode (unless otherwise specified)</b> |                                     |                                                                                                                  |     |     |     |     |               |
| $V_{(BR)R}$                                   | reverse breakdown voltage           | $I_R = 100\ \mu\text{A}$ ; $T_j = 25\ ^\circ\text{C}$                                                            | [1] | 200 | -   | -   | V             |
| $V_F$                                         | forward voltage                     | $I_F = 3\ \text{A}$ ; $T_j = 25\ ^\circ\text{C}$                                                                 | [1] | -   | 870 | 940 | mV            |
|                                               |                                     | $I_F = 3\ \text{A}$ ; $T_j = 125\ ^\circ\text{C}$                                                                | [1] | -   | 730 | 820 | mV            |
| $I_R$                                         | reverse current                     | $V_R = 200\ \text{V}$ ; $T_j = 25\ ^\circ\text{C}$                                                               | [1] | -   | -   | 1   | $\mu\text{A}$ |
|                                               |                                     | $V_R = 200\ \text{V}$ ; $T_j = 125\ ^\circ\text{C}$                                                              | [1] | -   | 1.5 | 35  | $\mu\text{A}$ |
| $C_d$                                         | diode capacitance                   | $V_R = 4\ \text{V}$ ; $f = 1\ \text{MHz}$ ; $T_j = 25\ ^\circ\text{C}$                                           |     | -   | 37  | -   | pF            |
| $t_{rr}$                                      | reverse recovery time step recovery | $I_F = 0.5\ \text{A}$ ; $I_R = 1\ \text{A}$ ; $I_{R(\text{meas})} = 0.25\ \text{A}$ ; $T_j = 25\ ^\circ\text{C}$ |     | -   | 13  | 30  | ns            |
|                                               | reverse recovery time ramp recovery | $dl_F/dt = 50\ \text{A}/\mu\text{s}$ ; $I_F = 1\ \text{A}$ ; $V_R = 30\ \text{V}$ ; $T_j = 25\ ^\circ\text{C}$   |     | -   | 22  | -   | ns            |
|                                               | reverse recovery time               | $dl_F/dt = 100\ \text{A}/\mu\text{s}$ ; $I_F = 1\ \text{A}$ ; $V_R = 30\ \text{V}$ ; $T_j = 25\ ^\circ\text{C}$  |     | -   | 17  | -   | ns            |
| $I_{RM}$                                      | peak reverse recovery current       | $T_j = 25\ ^\circ\text{C}$                                                                                       |     | -   | 1   | -   | A             |
| $Q_{rr}$                                      | reverse recovery charge             |                                                                                                                  |     | -   | 10  | -   | nC            |
| $V_{FRM}$                                     | peak forward recovery voltage       | $I_F = 1\ \text{A}$ ; $dl_F/dt = 50\ \text{A}/\mu\text{s}$ ; $T_j = 25\ ^\circ\text{C}$                          |     | -   | 815 | -   | mV            |

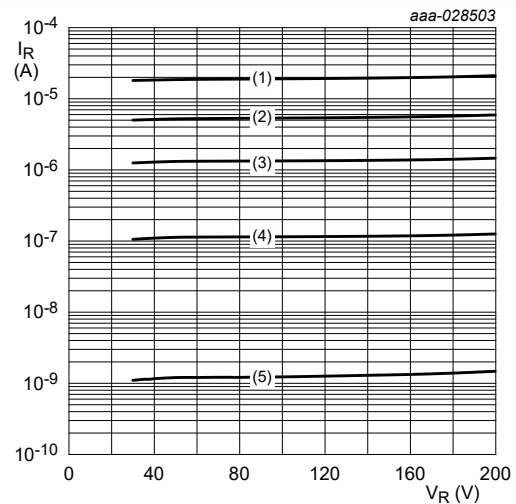
[1] Very short pulse, in order to maintain a stable junction temperature.



pulsed condition

- (1)  $T_j = 175\ ^\circ\text{C}$
- (2)  $T_j = 150\ ^\circ\text{C}$
- (3)  $T_j = 125\ ^\circ\text{C}$
- (4)  $T_j = 100\ ^\circ\text{C}$
- (5)  $T_j = 85\ ^\circ\text{C}$
- (6)  $T_j = 25\ ^\circ\text{C}$
- (7)  $T_j = -40\ ^\circ\text{C}$

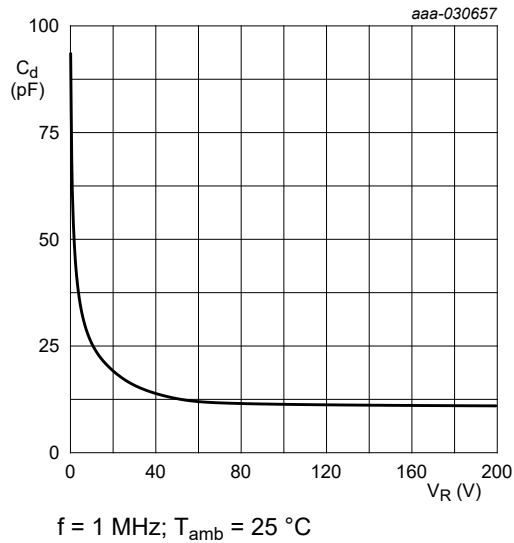
**Fig. 3. Forward current as a function of forward voltage; typical values**



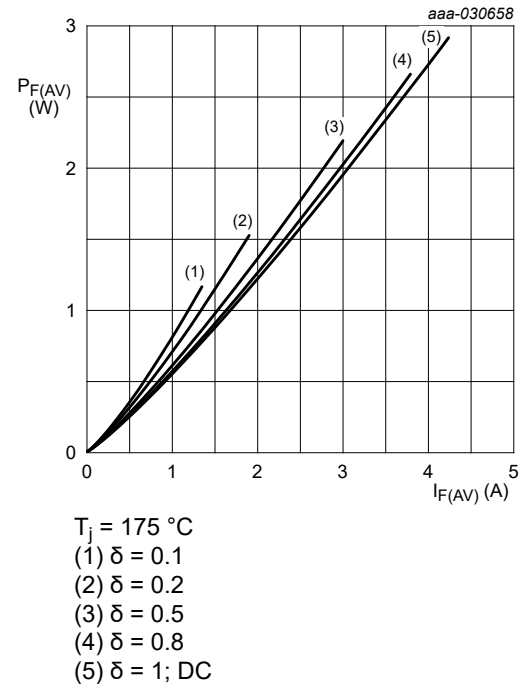
pulsed condition

- (1)  $T_j = 175\ ^\circ\text{C}$
- (2)  $T_j = 150\ ^\circ\text{C}$
- (3)  $T_j = 125\ ^\circ\text{C}$
- (4)  $T_j = 85\ ^\circ\text{C}$
- (5)  $T_j = 25\ ^\circ\text{C}$

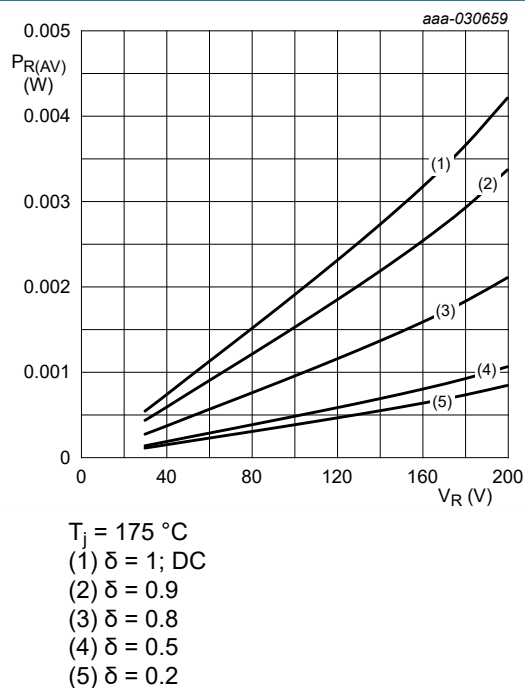
**Fig. 4. Reverse current as a function of reverse voltage; typical values**



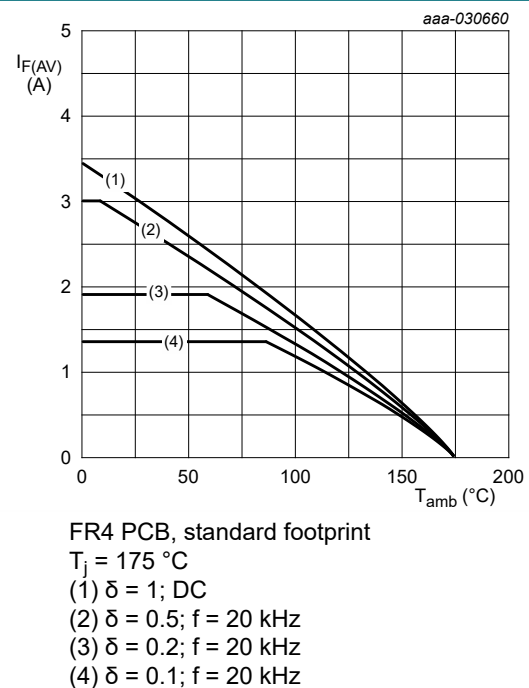
**Fig. 5.** Diode capacitance as a function of reverse voltage; typical values



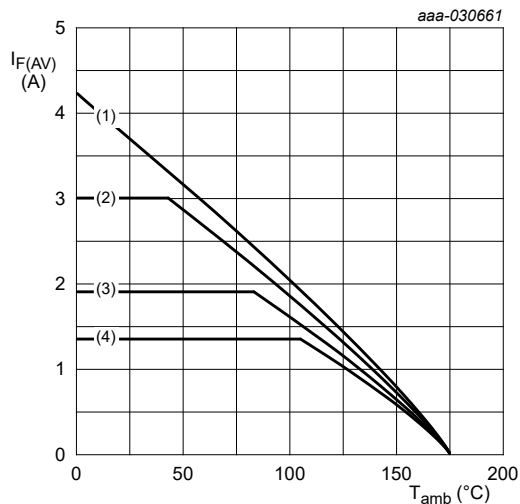
**Fig. 6.** Average forward power dissipation as a function of average forward current; typical values



**Fig. 7.** Average reverse power dissipation as a function of reverse voltage; typical values

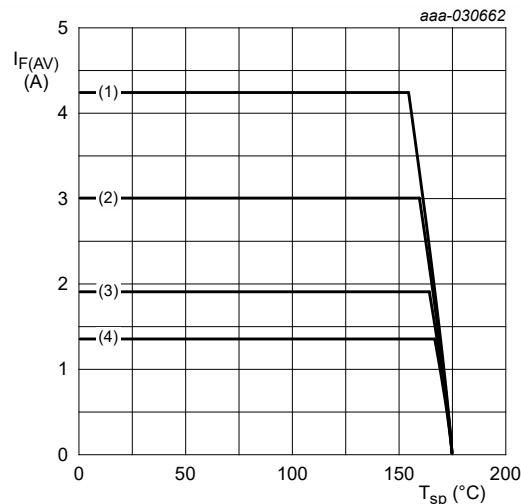


**Fig. 8.** Average forward current as a function of ambient temperature; typical values



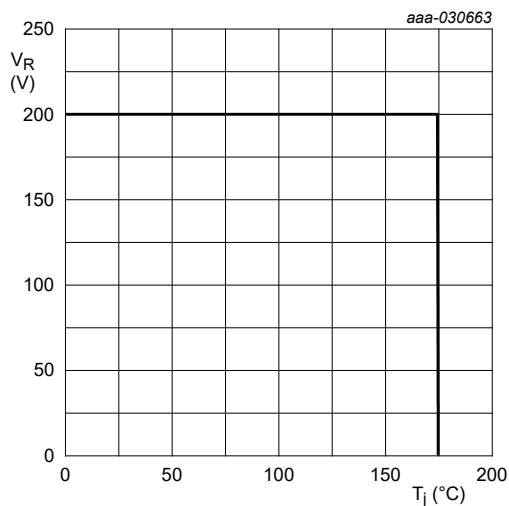
FR4 PCB, mounting pad for cathode 1 cm<sup>2</sup>  
 $T_j = 175$  °C  
(1)  $\delta = 1$ ; DC  
(2)  $\delta = 0.5$ ;  $f = 20$  kHz  
(3)  $\delta = 0.2$ ;  $f = 20$  kHz  
(4)  $\delta = 0.1$ ;  $f = 20$  kHz

Fig. 9. Average forward current as a function of ambient temperature; typical values



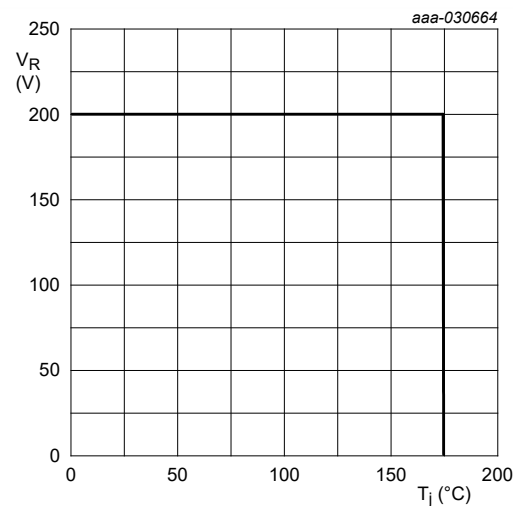
$T_j = 175$  °C  
(1)  $\delta = 1$ ; DC  
(2)  $\delta = 0.5$ ;  $f = 20$  kHz  
(3)  $\delta = 0.2$ ;  $f = 20$  kHz  
(4)  $\delta = 0.1$ ;  $f = 20$  kHz

Fig. 10. Average forward current as a function of solder point temperature; typical values



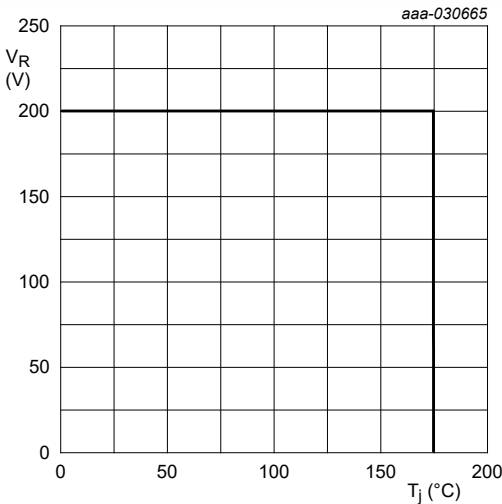
FR4 PCB, standard footprint  
 $R_{th} = 90$  K/W

Fig. 11. Derated maximum reverse voltage as a function of junction temperature; typical values



FR4 PCB, mounting pad for cathode 1 cm<sup>2</sup>  
 $R_{th} = 70$  K/W

Fig. 12. Derated maximum reverse voltage as a function of junction temperature; typical values



Soldering point of cathode tab  
 $R_{th} = 7 \text{ K/W}$

Fig. 13. Derated maximum reverse voltage as a function of junction temperature; typical values

11. Test information

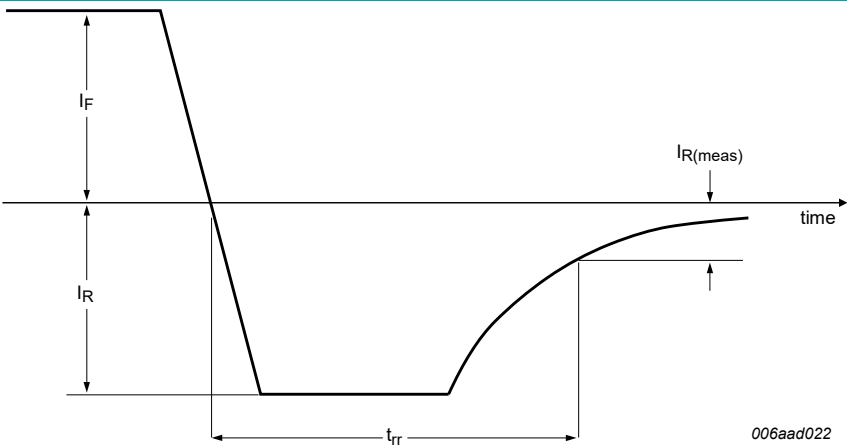


Fig. 14. Reverse recovery definition; step recovery

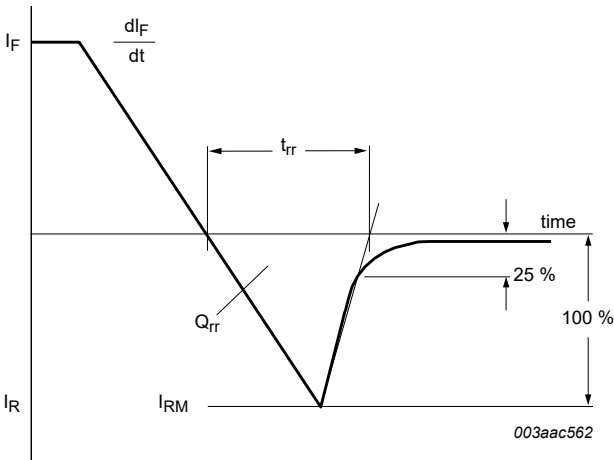


Fig. 15. Reverse recovery definition; ramp recovery



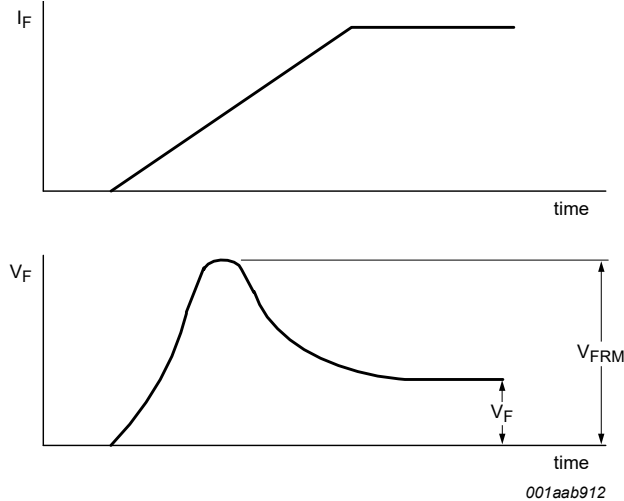


Fig. 16. Forward recovery definition

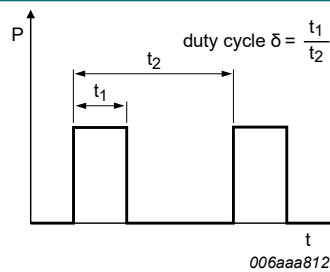


Fig. 17. Duty cycle definition

The current ratings for the typical waveforms are calculated according to the equations:

$$I_{F(AV)} = I_M \times \delta \text{ with } I_M \text{ defined as peak current}$$

$$I_{RMS} = I_{F(AV)} \text{ at DC, and } I_{RMS} = I_M \times \sqrt{\delta}$$

with  $I_{RMS}$  defined as RMS current.

### Quality information

This product has been qualified in accordance with the Automotive Electronics Council (AEC) standard Q101 - Stress test qualification for discrete semiconductors, and is suitable for use in automotive applications.

12. Package outline

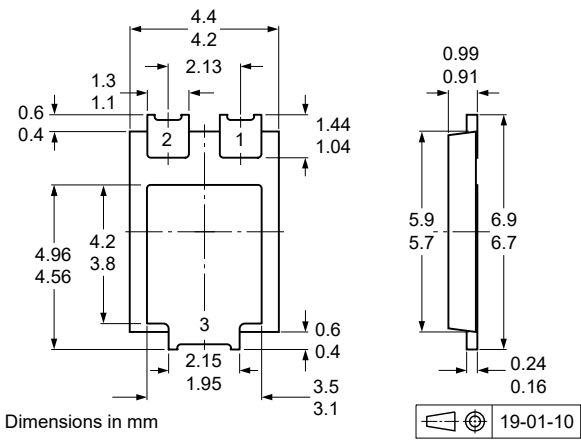


Fig. 18. Package outline CFP15B (SOT1289B)

13. Soldering

Footprint information for reflow soldering of CFP15B package

SOT1289B

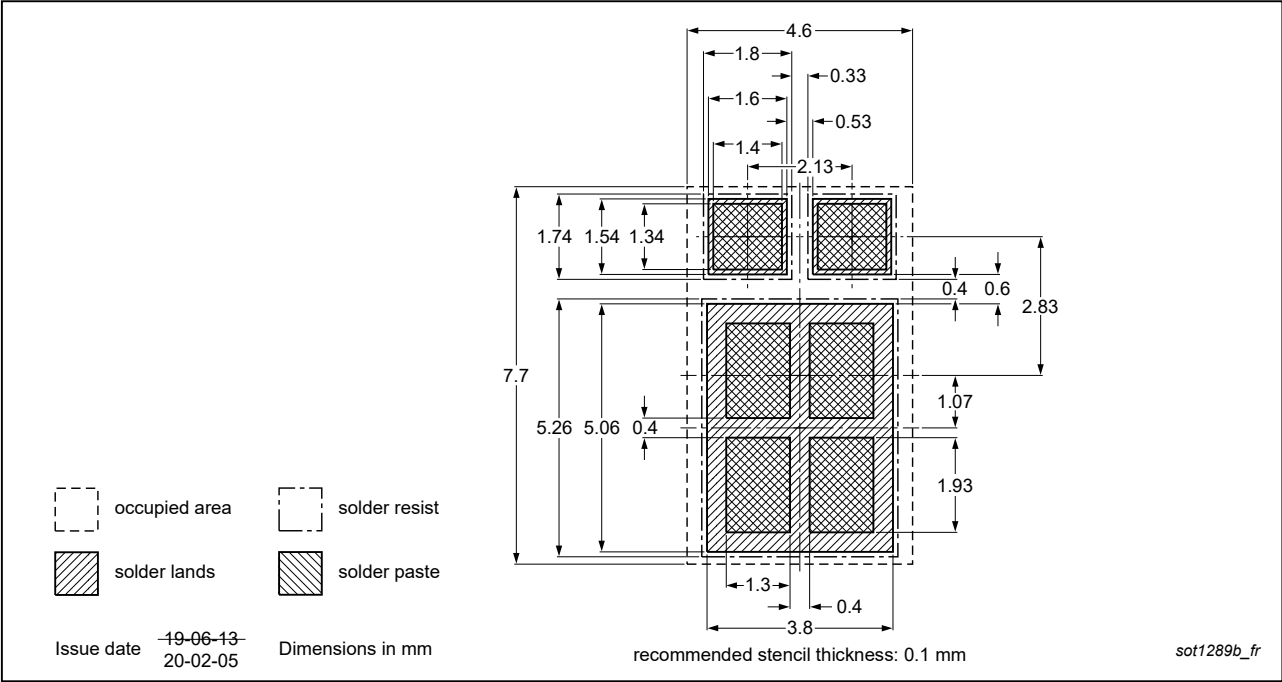


Fig. 19. Reflow soldering footprint for CFP15B (SOT1289B)

14. Revision history

Table 8. Revision history

| Data sheet ID     | Release date | Data sheet status  | Change notice | Supersedes |
|-------------------|--------------|--------------------|---------------|------------|
| PNE20060CPE-Q v.1 | 20210910     | Product data sheet | -             | -          |

## 15. Legal information

### Data sheet status

| Document status<br>[1][2]      | Product status [3] | Definition                                                                            |
|--------------------------------|--------------------|---------------------------------------------------------------------------------------|
| Objective [short] data sheet   | Development        | This document contains data from the objective specification for product development. |
| Preliminary [short] data sheet | Qualification      | This document contains data from the preliminary specification.                       |
| Product [short] data sheet     | Production         | This document contains the product specification.                                     |

- [1] Please consult the most recently issued document before initiating or completing a design.
- [2] The term 'short data sheet' is explained in section "Definitions".
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